I. INTRODUCTION

We propose to measure with the CEBAF Large Acceptance Spectrometer (CLAS) the exclusive electroproduction of the vector mesons ρ, ω and ϕ on the nucleon in the Bjorken regime ($Q^2, \nu \gg$ and $x_B = \frac{Q^2}{2M\nu}$ finite). The study of the x_B and t dependence of these reactions in the Bjorken regime holds promise, through perturbative QCD, to access new structure functions of the nucleon, the so called "Off-Forward Parton Distributions" (OFPD's) [1] [2] [3] [5]. These structure functions are a generalization of the parton distributions measured in the deep inelastic scattering experiments and their first moment links them to the elastic form factors of the nucleon. Furthermore, Ji [1] has shown that their second moment gives access to the sum of the quark spin and the quark orbital angular momentum to the nucleon spin, which may shed a new light on the "spin-puzzle". It is clear that the actual determination of the OFPD's will require a more extended and ambitious experimental program. Our goal is to make a first step in this direction. Namely, we propose to test experimentally the Q^2 scaling law predicted by pQCD in the Bjorken regime. This is a prerequisite to the development of this field.

The combination of the Jefferson Lab (JLab) 6 GeV continuous electron beam and of the large acceptance CLAS detector will allow to reach values in Q^2 up to $\approx 4.$ GeV^2 with reasonnable count rates. More precisely, from an experimental point of view, one has to identify the reaction channels $\gamma^*_L p \to p(\rho^0_L, \omega_L, \phi_L)$ where the index L stands for the *longitudinal* polarization state of the particles. For these channels, perturbative QCD (PQCD) at leading order predicts that the longitudinal differential cross-section $\frac{d\sigma_L}{dt}$ follows a $\frac{1}{Q^6}$ dependence [3].

The experimental program that we propose consists in several points :

- Measure the Q^2 dependence of the reactions $\gamma^*_L p \to p(\rho^0_L, ...)$ up to $Q^2 \approx 4$ GeV^2. This will allow to study the transition from meson exchange mechanisms at low Q^2 to quark exchange processes at larger Q^2. At higher values of Q^2, one will test the onset of the $\frac{1}{Q^6}$ scaling behavior of the cross section predicted by PQCD.

- The longitudinal vector mesons (ρ^0_L, ...) will be identified through the vector meson decay angular distribution. Assuming SCHC (s-channel helicity conservation) [4] permits to extract the cross section for the reaction $\gamma^*_L p \to p(\rho^0_L, \omega_L, \phi_L)$. We will check the validity of the SCHC hypothesis by studying those vector meson decay density matrix elements that are zero when SCHC applies.

- If we indeed reach the Bjorken regime where scaling shows up, an analysis of the x_B and t dependence of the cross sections may allow a first exploratory analysis of the OFPD's.

This experiment is the first one to explore this new domain of hadronic physics : the OFPD's. This subject is currently in full expansion on the theoretical side. Other experimental facilities, such as COMPASS and HERMES, are currently considering a similar study of the OFPD's. In spite of the relatively "low" energy of the incident beam, the high luminosity and the better resolution that one can reach with CLAS will allow equivalent count rates to the two other facilities in the same kinematical range (but in a closer and shorter period). The perspective of a rich experimental program opens up for the coming decade.

Exclusive photo- and electroproduction of vector mesons is also receiving a renewed interest in other kinematical regimes investigated in two other JLab experiments that are currently taking data. Firstly, Exp. 93-031 [7] studies of the photoproduction of vector mesons (with a special emphasis on the ϕ) at large t to see possible manisfestations of hard scattering mechanisms compared to the traditional diffractive Pomeron exchange mechanism in photoproduction at low t. Another experiment (Exp. 93-022 [8]) addresses the issue of a possible strange component in the ground state of the nucleon, via the electroproduction of ϕ meson at moderate momentum transfers (Q^2 values up to 2 GeV^2).

In the present experiment, we propose to investigate the electroproduction of vector mesons at moderate energies (W in the range 2 - 3 GeV) but high virtuality Q^2 (Q^2 up to 4 GeV^2) of the photon to study the link between these electroproduction cross sections and the OFPD's.

We begin by reviewing in Section II the physics motivation of the OFPD's. In Section III, the status of the existing data will be discussed. The measurement proposed is presented in Section IV and the estimates and simulations are shown that we carried out to show the feasibility of this experiment at Jefferson Lab with the CLAS detector.

II. THE PHYSICS CASE

We now give a brief overview of the physics of the OFPD's. The following calculations and developments for this vector meson electroproduction experiment were mainly performed by M. Vanderhaeghen and are presented in Refs. [5] [6]. The detailed theoretical formalism and the definitions of the kinematical variables are presented in the Appendix.

Recently, Ji [1] and Radyushkin [2] have proposed that Deeply Virtual Compton Scattering (DVCS) in the Bjorken regime ($Q^2, \nu \gg$ and $x_B = \frac{Q^2}{2M\nu}$ finite) could be used to access a new type of parton distributions, generally referred to as "Off-Forward Parton Distributions" (OFPD's). They have shown that the leading order DVCS amplitude in forward direction can be factorized in a hard scattering part (exactly calculable in PQCD) and a nonperturbative nucleon structure part as is illustrated in Fig.(1).